hibitions. Photograph 2 shows a number of such groups, each group consisting of three or four mounts and arranged according to the economic importance of the insects represented, e. g., one group contains insects of the household (clothes moth, cheese skipper and carpet beetle) and another includes three shade tree pests (the horned tail, tussock moth, and leopard moth.) Students and visitors show considerable interest in these exhibits and, perhaps unconsciously, derive a great deal of information from them.

3. A method of displaying insect galls. Biologically the gall insects are among the most interesting of the whole class. The insect galls may be prepared for exhibition in the following manner (see Photo 3.) Racks three feet long, eight inches high, and two and one half inches deep are made, with the top piece hinged at both ends. Strips on the edges at the top and bottom prevent the bottles from falling out. Galls on stems are dried and placed in large mouthed vials about two inches in diameter, and a label is placed at the bottom. Galls on leaves are preserved in 10% formalin and placed in bottles about two and one half inches in diameter. The bottles or vials fit loosely enough in the racks so that they can be turned around and all sides of the galls can thus be examined but their removal is prevented by the strip near the top and bottom. If, however, it becomes necessary to take out a bottle, the hinge at one end of the top can be disjointed and the desired specimen removed. A background of white cardboard helps to bring out the characteristics of the galls. Such a rack as that described may, of course, be used for other material both zoological and botanical.

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THE SEDGWICK-RAFTER OCULAR MICROMETER AND ITS USES

In 1889 Prof. W. T. Sedgwick and Mr. George W. Rafter developed the so-called Sedgwick-Rafter method for enumerating microscopic organisms to be found in water,—a procedure which has since come into general use among biologists, chemists and engineers investigating or in charge of water supplies, and has been incorporated as a part of the Standard Methods of Water Analysis adopted

by the American Public Health Association. This process, the details of which need not be mentioned here, involves the concentration of organisms by means of a sand filter and the microscopic examination of cubic millimeter volumes of the concentrate. The ocular micrometer which was devised for the purpose of ruling off a square millimeter surface on the "ringed" slide has been found useful not only in the enumeration and identification of organisms, but also in the broad field of general microscopic work and perhaps deserves a word of commendation to microscopists.

The micrometer is sub-divided as shown in the accompanying diagram and when used with an ocular of the No. 4-x Spencer type (2 inch) and a 16 mm. objective, can be so standardized by the aid of a stage micrometer that the large square will outline a square millimeter surface. The smallest square will then be 20 micra on a side and the micrometer will form a convenient measure for the larger microscopic objects. By only a slight change in the tube length, moreover, a standardization with the 4 mm. objective can be made which will increase the magnification five-fold, thereby reducing the side of the large square to 200 micra and that of the smallest square to four, so that, with the high power, the dimensions of all but the very smallest microscopical organisms can be readily obtained.

But ready adaptability to either high or low powers of the microscope is not the only commendable feature of this type of micrometer. There is a marked advantage in the way it is ruled into squares of various sizes. It enables one to measure the length and the breadth of an object at the same time and yet leaves the greater part of the field of vision relatively free from lines interfering with clear definition of objects. It is thus adapted to the use of the beginner as well as to that of the seasoned microscopist. The student beginning microscopic work in zoölogy, botany or histology, for example, is studying anatomy with no basis or standard of size-comparison, other than that offered by different objects in the same field. The standardization and use of the micrometer gives him an appreciation of the magnifying power of the microscope by demonstrating the apparent size of a familiar and fundamental unit, the square millimeter, and teaches him the approximate relative

size of the microscopical linear unit or micron. The student finds the device convenient to handle, and easy to use and soon acquires a mental scale of unit areas by which he can estimate the size of organisms or other structures in micra much as he judges of macroscopic structures in centimeters or inches.

Ocular micrometers may be prepared either by engraving or photography and are not difficult to procure. Engraved micrometers are somewhat superior and are sold by Bausch and Lomb under the name of "Whipple's Eye-Piece Micrometer" at $3.50 each. Those made by photography are much less expensive and have been found entirely satisfactory. In either case, the actual size of the large square ruled on the glass should be 7 mm. on a side. In photography the lines are produced on lantern-slide glass by photographing a specially prepared sketch. The glass is then cut and mounted on a clean cover slip with gum damar. The only difficulty in using this type arises from the fact that the lantern-slide glass is rather thick and cannot be perfectly cleared without removing the fine lines. The fault is not serious, however, and may be readily overlooked if expense must be considered, for these micrometers can be made for about 75c each.* This is relatively very inexpensive, for the common linear ocular micrometer, which is much less adapted to work with living forms and hardly more valuable for exact measurements, is not obtainable for less than $1.25.

The advantages of this type of micrometer are its ready adaptability to general use with either high or low powers of the microscope; the definition of measured squares or unit surfaces, which are easier to use and to fix in mind than are linear units; a comparatively unobstructed "field"; and (in the photographic product) low cost.

*Unmounted ocular micrometers may be secured at this price from Mr. B. S. Turpin, 30 Trinity Place, Boston, Mass.

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